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FACTORS AFFECTING THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) FOR AGRICULTURAL INFORMATION AMONG SMALLHOLDER FARMERS IN CHITWAN AND LAMJUNG DISTRICTS OF NEPAL

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ABSTRACT

ICT have power to enrich smallholder farmers to the agriculture information and to promote sustainable agricultural development, particularly in the developing countries. An investigation was done during 2019 to know the about the factors affecting the use of ICT with respect to agriculture information by smallholder farmers in Chitwan and Lamjung districts of Nepal. The study areas were selected purposely whereas a total of 120 smallholder farmers (60 farmers from each district) were selected randomly. Pre-tested semi structured interview schedule was used for household survey, whereas respective checklists were used for Focus Group Discussion (FGD) and Key Informant Interview (KII) to gather primary data. Findings from the logit model revealed that use of ICT increases with farming experience, and contact with extension worker, and decreases with age, education and net worth. Hence, it was well revealed that ICT based agriculture information delivery is effective to the young smallholder farmers having regular contact with extension worker and having longer farming experience at the present scenario.

Keywords: Age, education, experience, extension worker.

INTRODUCTION

Nepalese agriculture is mainly subsistence, practiced by smallholder farmers with their own traditional knowledge (GC & Hall, 2020). Farmers face hardship to access better agricultural information on farm management, farming practices and technology resulting lower production, lower usage of improved farming practices and poor adoption of innovation (Adomi *et al.*, 2003; Oladele, 2006). Due to insufficient extension personnel's and less extension coverage (MoAD, 2016), Government and private sectors providing extension services are not able to benefit the farmers as expected and with time, there emerged the concept of ICT based advisory services for delivery of extension service in Nepal (Paudel *et al.*, 2018). ICT include radio, television, internet, mobile phone, software application and others which provide cost effective advisory services to farmers (Oladele, 2015). Further, ICT aid in better farm decisions (Singh *et al.*, 2015) and promote farm efficiency through the introduction of improved technologies among farming communities (Das, 2016). Smallholders constitute more than 50% of Nepalese farmers, cultivating less than 0.5 ha per household (CBS, 2011). Though, smallholder production is important for household food security and sustainable livelihood, their productivity is quite low (Baiphethi & Jacobs, 2009). Households are either abandoning or are uninterested in agricultural production due to poor yields. Therefore, it is necessary to increase the productivity of small holder farmers significantly to ensure long term food security (Alpízar, 2020). This can be achieved by encouraging smallholder farmers to pursue sustainable intensification of production through improved inputs and technology (Baiphethi & Jacobs, 2009; Kante *et al.*, 2017).

Rapid development in ICT has a huge potential for improving farmers information access as ICT based agriculture extension is very beneficial in creating the awareness to the farming communities (Wawire *et al.*, 2017; Eskia, 2019). ICT can significantly contribute to smallholder farmer's progress in agriculture sector ensuring food security and sustainable livelihood (Yaseen *et al.*, 2016; Kaddu, 2011). Likewise, the flow of information through ICT helps farmers to connect and communicate even in the rural areas (Saravanana, 2010). Smallholder farmers often face confusion when it comes to determining the specific produce they should cultivate, deciding on the appropriate market for selling their produces, eliminating agents/intermediaries, and implementing techniques to improve efficiency (Abebaw & Yared, 2019; Bosch *et al.*, 2012). ICT helps farmers to get the lacking information related to their farming, production efficiency, profit making strategies and the pricings (Iortima, 2012). This helps in increasing yield and profitability through the adoption of productivity enhancing technologies along with better market information to farmers (Wawire *et al.*, 2017; Eskia, 2019). Empirical evidence on factors affecting the use of ICT by small holder farmers is lacking in Nepal. Therefore, the present study aims to bridge that knowledge gap.

MATERIALS AND METHODS

Study area

Hills and tropical plain terai are main agro-ecological regions of Nepal. Lamjung district represents hills and Chitwan district represents terai region in this study. Government institutions and bodies like metropolitan and municipality, Agriculture Knowledge Center (AKC), Prime Minister Agriculture Modernization Project (PMAMP), private sectors and I/NGOs like Li-bird are implementing projects to promote ICT in agriculture in these districts. ICT in agriculture is relatively new technology among farming communities. ICT with respect to agricultural information are well functioning in these districts and has potential for rapid expansion. In Chitwan district, survey was carried out in Bharatpur metropolitan city ward 15 and in Lamjung district, survey was carried out in Sundarbazar municipality ward 7. Farming system is dominated by rice, vegetables and livestock in survey site.

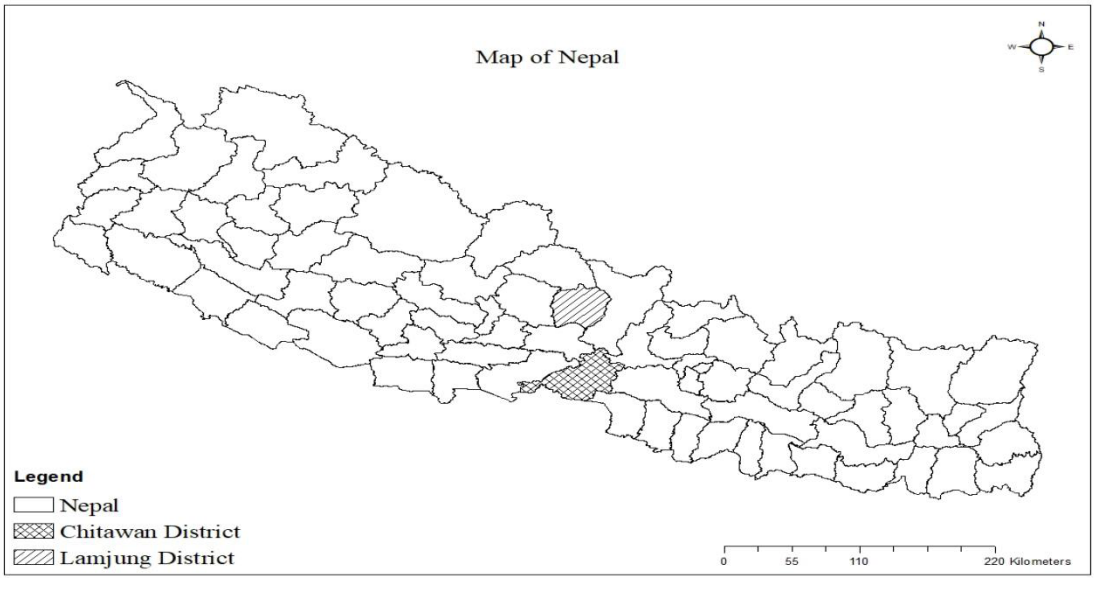

Figure 1. Map of Nepal showing Chitwan and Lamjung district Sampling technique, population and sample size

We employed multistage, purposive and random sampling in 2019 to select district, respective metropolitan and municipality, and smallholder farmers. The districts were selected purposively to represent two main agro-ecological regions of Nepal. In each district, survey site were purposively selected considering access to different ICT tools among farmers and availability of both ICT users and non users. Population for this study was farmers who were involved in small holding agricultural practices (less than 0.5 ha farm size). Through discussion with AKC, respective metropolitan/municipality and agricultural cooperatives we figured out a total of 415 smallholder farmers in survey site of Chitwan district and 398 smallholder farmers in survey site of Lamjung district. To calculate sample size, we used the formula (Daniel, 1999);

$n = N*X / (X + N - 1)$,

Where,

$X = Z_{\alpha/2}^{2} *p*(1-p) / MOE^2$,

and $Z_{\alpha/2}$ is the critical value of the Normal distribution at α/2, MOE is the margin of error, p is the sample proportion, and N is the population size.

Sixty (60) smallholder farmers were selected randomly from each district making total sample size of 120. Sample size was further divided into two categories of ICT users and non-users. Primary data for the study was collected from the direct household interviews with household head using semi structured interview schedule. One (1) Focus Group Discussion (FGD) and 1 Key Informant Interview (KII) was carried out in each district in order to validate the reliability and authenticity of primary data collected from household survey. Secondary data was obtained from reports of government bodies and institutions, I/NGOs and others.

Empirical model

Descriptive analysis and *t*-test was done using IBM SPSS Statistics 25. Logit model was employed using Stata/SE 12.1 in order to determine the factors affecting the use of ICT for agricultural information among smallholder farmers. Further, to assess the effect of each independent variable on the smallholder farmers' use to ICT, marginal effect on those variables was estimated in the logit model.

Model specification

$Zi=\ln[Pi/(1-Pi]=a+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X_7+b_8X_8+b_9X_9+b_{10}X_{10}+b_{11}X_{11}+U$

Where,

Pi= Is the probability of use and no use of ICT

Pi=1 indicates use of ICT

Pi=0 indicates no use of ICT

Dependent variable:

Zi= Probability of use of ICT

Independent variables:

X_1 = Age (Continuous)

X_2 = Gender (dummy)

X_3 = Education (Continuous)

X_4 = Family size (Continuous)

X_5 = Farm size (Continuous)

X_6 = Farming experience (Continuous)

X_7 = Distance to nearest agriculture center (Continuous)

X_8 = Distance to nearest ICT center (Continuous)
X_9 = Contact with extension worker (dummy)
X_{10} = Income (Continuous)
X_{11}= Net worth (Continuous)
a= Intercept
b_1 to b_{11}= Regression coefficients of the dependent variables
U= Error terms
The description of variables used is presented in Table 1.

The marginal probability of the factors influencing the use of ICT was estimated based on expressions derived from the marginal effect of the logit model.

$$dZ/dQ = \beta_i [Pi(1 - Pi)]$$

Where,
βi = Estimated logit regression coefficient with respect to the ith factor
Pi = Estimated probability of using ICT by smallholder farmers

RESULTS AND DISCUSSION

Descriptive statistics

Table 1. Descriptive statistics of the dependent and independent variables used in the study

Variables	Description	Mean	Standard Deviation
Dependent Variable			
Use of ICT	=1 if respondent use ICT in agriculture, 0 otherwise	0.63	0.48
Independent variable			
Age	Age of the respondent (years)	45.66	13.27
Gender	Gender of the respondent (=1if male, 0 female)	0.53	0.50
Education	Formal education of the respondent (years)	7.80	4.81
Family size	Number of people living in household	4.11	1.33
Farm size	Own land used for agricultural practices (kattha)	9.04	4.45
Farming experience	Farming experience of respondent (years)	26.61	11.41
Distance to agriculture center	Distance between household and nearest agriculture center (km)	2.48	2.69
Distance to ICT center	Distance between household and nearest ICT center (km)	2.44	2.61
Contact with extension worker	=1 if respondent has regular contact with extension worker, 0 otherwise	0.16	0.37
Income	Annual income of household (NPR)	578610.70	403366.60
Net worth	Net worth of household (NPR)	13600000.40	14800000.20

Source: Field survey (2019)
Note: 1 USD=113.32 NPR; 0.5 ha=14.79 kattha

Summary statistics and explanation of the variables are presented in Table 1. As observed, 63% of the respondents were using ICT for agricultural information. The average age of the respondents was 45.66 years. On average, 53% of the respondents were male and had 7.80 years of formal schooling. Household size on average was of 4.11 members and mean farm size was 9.04 kattha. Average farming experience of the respondents was 26.61 years. Respondents' household, on average, was 2.48 km from nearest agriculture center and 2.44 km from nearest ICT center. Only 16% of the respondents had regular contact with the extension worker. Respondents' household on average earned NPR.578610.70 in a year and had current net worth of NPR 13600000.40.

Difference in characteristics between ICT users and non-users

Table 2. Characteristics of ICT users and non users observed in the study

Variables	Users	Non-users	Differences	t- value
Age	44.84	47.07	-2.23	-0.89
Gender	0.58	0.43	0.15	1.56
Education	6.89	9.36	-2.47	-2.79***
Family size	3.93	4.41	-0.48	-1.90*
Farm size	7.82	11.15	-3.33	-4.23***
Farming experience	28.12	24.00	4.12	1.93*
Distance to agriculture center	2.67	2.16	0.51	1.00
Distance to ICT center	2.59	2.16	0.44	0.89
Contact with extension worker	0.22	0.05	0.18	2.63*
Log(Income)	12.98	13.02	-0.40	-0.25
Log(Net worth)	6.37	7.09	-0.71	-5.35***

Source: Field survey (2019)
Note: ***, * indicate significant at 1%, 10% level of significance, respectively. Log indicate log transformation value.

The results of differences between means of characteristics describing ICT users and non-users are presented in Table 2. There was a significant difference in education of the respondents, family size of the household, farm size of the household, farming experience of the respondent, contact with extension worker and net worth of the household between ICT users and non-users. Farming experience of the respondents and contact with extension worker was significantly higher for ICT users compared with non-users. Similarly, education of the respondents, family size of the household, farm size of the household and net worth of the household was significantly higher for non-users compared with ICT users. There was no significant difference between two groups (ICT users and non-users) on other mentioned characteristics.

Factors affecting the use of ICT for agriculture information

Table 3. Logit regression analysis and marginal effect for factors affecting the use of ICT

Variables	Coefficient	*p*-value	SE	dy/dx	SE(dy/dx)
Age	-0.057**	0.014	0.023	-0.011	0.004
Gender	0.194	0.734	0.573	0.038	0.113
Education	-0.137**	0.030	0.063	-0.026	0.012
Family size	-0.185	0.382	0.212	-0.036	0.041
Farm size	-0.044	0.648	0.097	-0.008	0.019
Farming experience	0.065***	0.009	0.025	0.012	0.004
Distance to agriculture center	-0.042	0.962	0.894	-0.008	0.176
Distance to ICT center	0.108	0.905	0.908	0.021	0.178
Contact with extension worker	3.175***	0.001	0.940	0.353	0.682
Log(Income)	0.343	0.264	0.307	0.067	0.059
Log(Net worth)	-1.621***	0.004	0.567	-0.318	0.111
Constant	9.627	0.046	4.833		

Source: Field survey (2019)
Note: ***, ** indicate significant at 1%, 5% level of significance, respectively. SE: Standard Error. Log indicates log transformation value.

Logit regression analysis was done to assess the factors affecting the use of ICT and results are presented in Table 3. The wald test (LR chi^2) for the model showed that, the model had good explanatory power at the 1% level. Marginal effect was also driven from the regression coefficients as shown in Table 3. Result showed that age of the respondent, education of the respondent, farming experience of the respondent, contact with extension worker and net worth of the household were statistically significant in the use of ICT. Keeping other factors constant, with increase in age of the respondent by one unit, probability of use of ICT will decrease by 1.1 percent. This is possibly because with increase in age, farmers learning behavior relatively decrease; they fear risk and prefer the easiness. Thus hesitate in new technology adoption. This result is in line with Vosough *et al.* (2015). Keeping other factors constant, with increase in education of the respondent by one unit, probability of use of ICT will decrease by 2.6 percent. This is possibly because, formal education increase farmer's human capital and give them more opportunities for off farm employment which decreases their time and effort in farming, including adoption and implementation of new technology in farm. This scenario is mostly observed in small scale farmers who have higher tendency to work off farm (Uematsu & Mishra, 2010). Nyaupane and Gillespie (2009) found negative correlation of education with adoption of one of the best management practices (BMP). Gould *et al.* (1989) reported negative correlation of education with adoption of conservation tillage.

Keeping other factors constant, with increase in farming experience of the respondent by one unit, probability of use of ICT will increase by 1.2 percent. This is possibly because farmers having longer farming experience are progressive, have higher adaptability, ability to evaluate new technology, efficient decision making skills and relatively higher desire to improve farm practices; this will help them to gain more knowledge about use of ICT in agriculture and implement in farming practices. This result is in line with Vosough *et al.* (2015). Keeping other factors constant, if respondent has contact with extension workers, probability of use of ICT will increase by 35.3 percent. This is possibly because extension worker provide awareness about latest ICT resources, help to minimize the technical difficulties of ICT, initiate trainings and capacity buildup programs to promote digital literacy and help them to acquire context specific agricultural information more effectively. This result is in line with Vosough *et al.* (2015); Aldosari (2017); Muhammad *et al.* (2012). Keeping other factors constant, with increase in net worth of the respondent by one unit, probability of use of ICT will decrease by 31.8 percent. This is possibly because well-endowed farmers engage in off-farm income-earning activities more than the poorly endowed farmers (Gichuki *et al.*, 2020). With, higher proportion of off farm income to on farm income, farming settles down in their wish list hindering the adoption of new technology in agriculture.

CONCLUSION

ICT in agriculture has the potential to transform the existing farming practices to commercial and competitive through timely, accurate and adequate information flow to the farming communities. Thus, it favors the introduction of efficient and need based improved technology, efficient marketing channels and sustainable production practices that will improve the production and productivity. The study revealed that use of ICT in agriculture increases with increase in farming experience of the smallholder farmer and their contact with extension worker. Similarly, ICT in agriculture decrease with increase in age and education of the smallholder farmer and net-worth of the household. At the present context, ICT based agriculture information delivery should focus primarily on younger smallholder farmers. Smallholder farmers with less formal education and less net-worth, tends to focus on agriculture as sole means to livelihood and more emphasis should be given to such group. Smallholder farmers having longer farming experience tends to use ICT in agriculture and focus should be given to such group to transform their farming into commercial and competitive. ICT in agriculture is relatively new approach, hence at the initial stages extension services should be further strength to promote ICT in agriculture. Extension worker should be in regular contact with smallholder farmers and act as technical support to increase digital literacy of farmers. Further, extension workers should identify specific ICT tools based on capabilities of farmers, initiate training and capacity buildup trainings to promote behavioral changes towards ICT, minimize technical difficulties in the usage of ICT and facilitate monitoring and evaluation regarding ICT in agriculture to guide future interventions. Thus this is critical to realize that in order to increase the usage of ICT among the farming community, extension workers should work hard probably by adopting new ideas and ways of extension, such as sharing.

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AUTHOR'S CONTRIBUTION

B.P.Mishra: Participated in research design, data collection, data analysis and manuscript preparation.

U.P.Sigdel: Participated in research design and manuscript review.

D.Devkota: Participated in research design and manuscript review.

K.Devkota: Participated in research design and manuscript review.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest with present publication.

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